Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 1997		**00-00-1997 to 00-00-1997**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Hydrodynamic Stresses Driving Pore Pressure Changes in Sandy Coastal Sediments	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **SeaProbe Inc,501 Pine Street,Picayune,MS,39466**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

HYDRODYNAMIC STRESSES DRIVING PORE PRESSURE CHANGES IN SANDY COASTAL SEDIMENTS

Richard H. Bennett
SEAPROBE, INC
501 Pine Street
Picayune, MS 39466
phone: (601)798-9914 fax: (601)799-5391
email: rbennett@brutus.datastar.net
Award # N00014-97-C-0026

LONG-TERM GOALS

The project is directed toward the quantification of the first order forces responsible for the dynamic pore pressure behavior in sandy seafloor sediments in response to wave-induced bottom stresses. The effort is based on a three-dimensional field measurement approach. This project is 1) quantifying the ambient and dynamic pore water pressures and pore water pressure changes in selected coastal sediments and 2) measuring other environmental parameters in support of a NATO Mine Burial modeling study.

SCIENTIFIC OBJECTIVES

Objectives of the Phase I field exercise were designed to 1) test various instruments and equipment to be used in the full scale experiment and 2) collect environmental and sediment properties data in support of the NATO Mine Burial Modeling effort for prediction and evaluation of liquefaction and scour.. One crucial objective was to collect dynamic pore pressure data in a three dimensional configuration with multiple piezometers and collect numerous in situ electrical conductivity measurements to establish a strong statistical sediment properties data base of porosity and wet bulk density, and other sediment properties. Sediments were fine to medium sand. Water depth was 15-20 meters.

APPROACH

The NATO Phase I investigation is an in situ high resolution field instrumentation approach using a Multi-Piezometer Array System (MPAS) and electrical conductivity techniques. The Woods Hole Oceanographic Institution (WHOI) BASS instrumentation provided environmental measurements including wave induced bottom pressures, current velocity, turbidity, and conductivity.

WORK COMPLETED

A successful field exercise was completed off the coast of Holland. SEAPROBE coordinated all U.S. activities: the Multi-Piezometer Array System (MPAS), the BASS Tripod, and the C-C Probe deployments with European principals (Bennett, 1997).
The following measurements were completed.
MPAS: Multi-Piezometer Array System (ONR), Sediment Pore Pressure, Bottom Pressure.
BASS: Benthic Acoustic Stress Sensor, (BASS Tripod), Vector Flow Velocity, Conductivity, Bottom Pressure, Optical Back Scatter, Tripod Tilt & Roll, Magnetic Heading.
E-C Probe: Successful probe penetrations at 19 sites, good coupling to vibro-corer.

All systems are being repaired and serviced for the Phase II Field Exercise scheduled for Nov.-Dec. 1997.

RESULTS

WHOI BASS Tripod: The Woods Hole Oceanographic Institution (WHOI) Benthic Acoustic Stress Sensor (BASS) tripod was successfully launched and recovered. Contemporaneous measurements included the vector-flow velocity at three heights above the bottom, temperature at five heights, optical-back scatter at

five heights, and conductivity and pressure at one height above bottom. To enable rotation of sensor vector measurements into earth coordinates, tripod tilt, roll, and magnetic heading were recorded.

Electrical Conductivity measurements were attempted at 19 stations on all four sides of a 400 meter square test area and also within the test area. Because of a conductor failure within the electronics package, no meaningful electronic measurement data were collected. The system is designed to measure probe current, three selected voltages, temperature and depth of penetration into the sediment.

Multi-Piezometer Array System (MPAS): The MPAS consists of 12 piezometer probes each having 6 pressure transducers that measure the free-water column and sediment pore water pressure. Nine piezometer probes were deployed by divers in a 15 meter square array. Differential transducers measured sediment pore pressure and bottom pressure variability driven by surface-wave induced bottom pressures.

IMPACT/APPLICATIONS

The coupling of an object (mines, platforms, pipe lines, etc.) with the seabed and the combined dynamic interaction in response to hydrodynamic forcing is largely governed by the influence of waves and currents and the nature of the seabed materials. The processes are complex and reliable predictive capabilities (models, numerical formulations and quantitative estimates) must consider the combined effects of water column-seabed dynamics and the time dependent changes in their properties. Time constants for the dynamic behavior of the sediment vary significantly for sands, silts, clays and admixtures, and depend upon not only the nature and duration of the environmental forcing but also upon the fundamental nature of the sediment properties (Mei and Foda, 1981, Bennett et al. 1982, 1992a and b). A serious deficiency exist in the available in situ data bases necessary for the testing and evaluation of existing mine burial models for virtually all shallow water coastal sediment types in regions that have direct application to a variety of U.S. Naval activities.

TRANSITIONS

The project is providing important environmental data, sediment and water column measurements (BASS), and crucial data on the time-dependent pore pressure changes within a sandy sedimentary deposit. These data are important to studies of marine sediment stability, scour and potential liquefaction, strength changes, effective stress state, and the development of pore fluid gradients, through the sediment interface which directly affect mine burial, buried mine performance, and environmental assessments.

RELATED PROJECTS (Not Applicable)

REFERENCES

Bennett, R. H., J. T. Burns, T. L. Clarke, J. R. Faris, E. B. Forde, and A. F. Richards, 1982. Piezometer Probes for Assessing Effective Stress and Stability in Submarine Sediments. Marine Slides and Other Mass Movements, pp. 129-161.

Bennett, R. H., W. B. Sawyer, D. J. Walter, and E. N. Litman, 1992a. Pressure Attenuation and Geotechnical Properties in Surficial Marine Sediments: Gulf of Mexico Continental Shelf, NOARL Rpt. ID 020:360:92, 41p.

Bennett, R. H., W. A. Dunlap, H.J. Lee, J. R. Hooper, and S. A. Hughes, 1992b. Seabed-Structure Interaction, Workshop Report and Recommendations for Future Research, NOARL Tech. Note, 20p.

Bennett, R. H., 1997. Letter Report on Field Trials in the C-1 Area Off the Coast of Holland. SEAPROBE Technical Report, 36p.

Mei, C.C. and M.A. Foda., 1981. Wave-Induced Responses in a Fluid-Filled Poro-Elastic Solid with a Free Surface: A Boundary Layer Theory, Geophys. Journ, Astron,. Soc. Col. 66, pp.597-